DEMONSTRATION 2
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This is the second in a series of demonstrations to allow each reader to build a very simple and very inexpensive EH Antenna and experience the performance parameters of this new concept in antenna theory. As a prerequisite to this demonstration, Demonstration 1 must be completed because this one builds on the previous one.

This demonstration is designed to show that the EH Antenna develops radiation. Demonstration 3 will address antenna efficiency. Other demonstrations will follow to complete the antenna and allow you to use the antenna on the air. We will guide you through the construction and test of this antenna. Please read this document completely before working with the antenna.

Please be advised that previous EH Antenna designs used a 90 degree phase shift incorporated into the matching/phasing network to develop the EH concept. However, this design, known as the EH *STAR* Antenna, is based on the patented (pending) concept of developing the E field between the dipole elements (cylinders) while the H field is the result of the current on the cylinders caused by the differential voltage across each cylinder. The primary E field is the result of resonance where the capacity between cylinders and the inductance of the tuning coil form the resonant circuit, thus a high voltage is developed. Fortunately, the simple configuration of the antenna components provides the necessary phase shift to cause the E and H fields to be in phase, thus radiation occurs at the antenna.

ISOLATION COIL: Please modify the antenna with the following before you proceed: Add a small coil between the two cylinders, as shown in Figure 1. The purpose of this coil is to act as a phase delay. If the coil presents a nominal delay of 6 degrees while the antenna is radiating, the lead wire between the coil and the top cylinder will have sufficient phase delay to prevent it from radiating. Typically, two or three turns are adequate. More precisely, calculate the length of wire necessary to shift 6 degrees at the operating frequency, and then wind that length of wire around the support form. Add the coil before testing the radiation.

DEMONSTRATION 2: From Demonstration 1 we learned that this antenna has a large resistance. To achieve maximum radiation, the antenna must match the feed line impedance to allow maximum power transfer. Typically, that is 50 ohm coax. Therefore, we must develop a matching network to transform the radiation resistance of the antenna to 50 ohms.

The simplest matching network is also the best for this application. The antenna is connected as a parallel circuit (capacitor in parallel with the coil). To achieve a match to 50 ohms it is only necessary to tap the coil as shown in Figure 1.

To adjust this matching network, place a tap on the coil two turns above the bottom of the coil. Connect the test equipment to the antenna and determine the frequency where the reactance is 0. In other words, adjust the tuning coil for resonance at the desired frequency. A very simple way to do this is to measure the frequency of lowest VSWR. Change the amount of coil to move the antenna frequency to the desired frequency, and then adjust the tap until the best VSWR is obtained. This will take a little time because this is an interactive process, but you will be rewarded with low VSWR at the desired frequency. Please be aware that the VSWR Bridge built into your radio is not accurate at low transmitter power. Typically, 10 watts or more will allow accurate reading of VSWR.

SOURCE COIL

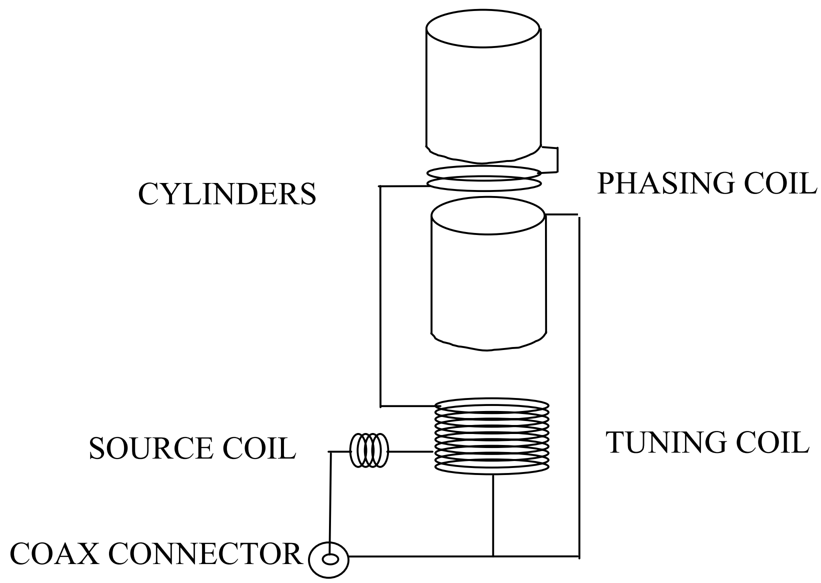

FIGURE 1 – TAPPED COIL IMPEDANCE MATCHING NETWORK.

RADIATION: The purpose of this demonstration is to show that the antenna radiates. Therefore, use a simple diode field strength meter with low transmitter power applied. If you have a signal generator available, 200 milliwatts is adequate. Other wise set the transmitter power to minimum. A simple field strength meter only displays the relative magnitude of the E field, not true radiation. However, for this antenna it will roughly indicate the shape of the radiation pattern by observing the relative field strength of the E field as a function of location of the field strength meter relative to the antenna.

The field strength meter can provide another valuable measurement, the +/- 3 dB bandwidth of the antenna. Set the transmitter power to nominally 10 watts or less. Position the field strength meter to give a reading above mid scale, preferably at maximum, with the transmitter frequency adjusted to give maximum radiation. This should occur very close to minimum VSWR. While observing the field strength, adjust the transmitter frequency until the strength is reduced to ½ the former value. 3 dB is equal to ½ the power. Because the diode detector is a square law detector, the meter movement will be equal to the square root of ½, or 0.707. Therefore, a 3 dB reduction in power is equal to the maximum reading multiplied by 0.707. Record the two frequencies (above and below center frequency) where the power is reduced by 3 dB. The difference between the two frequencies is defined as the 3 dB bandwidth. We can now calculate the Q of the antenna by dividing the center frequency by the bandwidth. Typically, the Q of a large dipole or vertical is about 30. You have just measured a miniature low Q antenna with a bandwidth comparable to a very large antenna.

While the antenna is inside a building there is some influence from metal in the building including power wiring and reinforcing material. The bandwidth may change when it is moved outside. Therefore, you may want to perform the measurement again for reference after it is moved.

AN EXCELLENT RECEIVING ANTENNA: All antennas are reciprocal. That is, a good transmitting antenna is also a good receiving antenna. Although the antenna has not yet been located outside where it can work best, try it as a receiving antenna. Compare received signals with those from your other antennas. Because it is located inside, the construction of the building will have a large effect on the performance. However, it should give a good account of itself unless the walls of your building have a large amount of metal in them.

The most common question relative to using a EH Antenna for receiving is related to the concept of "the bigger the better". For conventional Hertz antennas there is a concept of capture area. Small Hertz antennas do not have a large capture area, thus they do not produce high signal levels to the receiver. The EH Antenna provides the equivalent of full capture area, thus the receiver will indicate high signal levels equal to a large hertz antenna.

SUMMARY: You now have a miniature antenna with good bandwidth and high radiation. The Next demonstration will explore the efficiency of the EH Antenna and the effects of adding a feed line.

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